*water*

*Editorial*

# Microplastics and Their Impacts on Organisms and Trophic Chains

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## 1. Introduction to the Special Issue

Microplastic pollution is a global problem that has attracted extensive attention and has become a very hot topic in the scientific community. Microplastics are everywhere, such as in the ocean, wastewater, fresh water, soil, sediment, food, and air; thus, they are readily available for the surrounding organisms [1–5].

With respect to research on microplastics investigations and monitoring, the environmental transport process of microplastics and the toxicology of microplastics are extensively examined, and the aim is to improve the technical system of microplastics investigations and monitoring, grasp the laws of the environmental transport process of microplastics, reveal the toxicological effects of microplastics and their mechanisms, and carry out environmental benchmarking and risk studies of microplastics. The monitoring activities of microplastics have been carried out extensively for many years as essential supports for decision making and planning stages in the field of scientific activities and programming.

Recent advances in toxicology resulted in a greater understanding of the impact of microplastics on some specific aquatic organisms. When microplastics enter organisms, microplastics threaten biological health via oxidative stress, nerve injury, endocrine disruption, immune injury, and other mechanisms [6]. Furthermore, when microplastics exist in the environment, under certain conditions, the interaction between microplastics and persistent organic pollutants has uncertain effects on organisms. There is still much to be learned about their impact on trophic chains. Microplastics are known to be enriched in the marine environment along the trophic chain from phytoplankton to zooplankton and then to mammals [7]. Microplastics even enter the human food chain mainly from contaminated foods and can have a potential impact on human health [8]. However, the long-term effects of microplastics on human health require further study.

Additionally, the associated chemicals, such as plastic additives, can be released from the microplastics and cause harm [9], and their combined effect needs more attention as well. This Special Issue of *Water* should be of great help in increasing the number of studies, contributing to the scientific community and providing a comprehensive perspective on the impact of microplastics (including nanoplastics) and their additives. Our hope for this collection is that it brings together research papers and reviews on the research topic.

This Special Issue of *Water* comprises five original papers with contributions from 27 authors. Overall, the papers focused on several aspects of microplastic studies, such as microplastic abundance in coastal waters of Zhanjiang Bay, China [10], and two beaches in Sabah, Malaysia [11]; the trophic and ontogenetic transfer of microplastics in a near-natural exposure scenario [12] and in bloodsucking mosquitoes [13]; and toxicity effects of the nanoplastics exposed to larval Japanese Medaka [14].

## 2. Overview of the Contributions of the Special Issue

### *2.1. Microplastic Variations in Land-Based Sources of Coastal Water Affected by Tropical Typhoon Events in Zhanjiang Bay, China*

This paper aims to investigate the variations in the abundance, composition, diversity, and flux of microplastics in Zhanjiang Bay and to evaluate the effect of typhoon events on land-sourced microplastics. Samples were collected from survey stations at three estuaries and a land-source input outfall in Zhanjiang Bay. The results indicated that microplastics were transported from terrestrial sources to the coastal waters of Zhanjiang Bay under the influence of a typhoon, and the microplastic abundance showed significant temporal and spatial variations before and after the typhoon (3.6-fold higher after the typhoon, $p < 0.05$). The diversity of microplastics mostly increased after the typhoon event. The result highlights microplastic pollution in Zhanjiang Bay before and after the typhoon and provides theoretical support for future studies on microplastic pollution in coastal water ecosystems and the effects of typhoons on distributions of microplastics.

### *2.2. Identification, Abundance, and Chemical Characterization of Macro-, Meso-, and Microplastics in the Intertidal Zone Sediments of Two Selected Beaches in Sabah, Malaysia*

In this paper, the authors aim to investigate the abundance and chemical characterization of plastics in the intertidal zone sediments of two selected beaches in Kota Kinabalu city, Sabah, Malaysia. The heavy metals associated with the microplastics have been evaluated as well. The samples in two selected areas (ODEC, UMS public beach, and Kebagu public beach) show some differences, and the total weight of plastic collected in ODEC station was 13.4 g, while the sample from Kebagu station was 28.9 g. For the collection of samples, the research identifies the polymer types using Fourier transform infrared spectroscopy (FTIR) and observed the surface morphology by using a stereoscope, and the results show that compared with other polymers, PP and PE are the main types of plastics, and followed by PS and PET. Because Zn is widely used in the plastic industry, it was the metal with the highest concentration in all types of polymers from both selected beaches (up to 135.28 mg/kg in the sample). The findings show that the primary sources of plastics were highly related to human activities (e.g., fishing, plastic garbage from land and direct dumping of exfoliating products, and toothpaste); meanwhile, plastic particles observed as carriers of heavy metal pollutants, the surface properties, and the porosity of plastics contribute to their heavy metal absorption action when the plastic particles are released into the water column. The ingestion of microplastics, which results in the accumulation of metals, can thus be toxic, posing a serious concern for marine animals.

### *2.3. Uptake and Transfer of Polyamide Microplastics in a Freshwater Mesocosm Study*

In order to correctly investigate the effects of microplastics on aquatic animal populations and ecosystems and estimate the load and size of microplastics in the environment, this study investigated the microplastic trophic and ontogenetic transfer in a near-natural exposure scenario. This study focuses on *Chaoborus* sp. as a model organism, which feeds on zooplankton during the larval stage. To verify that *Chaoborus* sp. absorbs particles through the food chain, the authors set up two experiments: one was an outdoor freshwater mesocosms with a polyamide of (PA) 5–50 μm at concentrations of 15 and 150 mg/L, respectively, and the other was a control group without microplastics. The particle's density was at 1.13 g/cm.

The tests found up to 12 PA particles per larvae, while a small amount of plastic was found in the imagines. The data and other statistical analyses suggest that *Chaoborus* sp. absorbs PA particles via predation and that the absorption of PA particles increased in treatments with higher concentrations of plastics. The results suggest that although *Chaoborus* sp. absorbs large amounts of microplastics via predation, these contaminants may only remain in their bodies for a short time, and most of them are excreted by reflux and remain in the water, where they accumulate further and may cause harm to other organisms.

*2.4. Ontogenetic Transfer of Microplastics in Bloodsucking Mosquitoes Aedes aegypti L. (Diptera: Culicidae) Is a Potential Pathway for Particle Distribution in the Environment*

The paper studied the uptake and accumulation of microplastics by *Aedes aegypti L.* mosquitoes, which are carriers of vector-borne diseases, in the laboratory. In the experimental group, polystyrene (PS) particles were present at all life stages of the insects, from larvae to pupae and adults. *Aedes aegypti* L. larvae feed easily, accumulating an average of $7.3 \times 10^6$ entries over 3 days. From the larval stage to the pupal stage, the content of PS microspheres in mosquitoes was significantly reduced, and it was transmitted from the pupal stage to the adult stage without obvious losses. On average, 15.8 items were detected per pupae, and 10.9 items were detected per adult individual. *Aedes aegypti* L. reflected the absorption of microplastics. *Aedes aegypti* L. did not affect its survival rate, and at all life stages, the average weight of mosquitoes eating PS microspheres was higher than that of the control group. The data confirm that in metamorphosed insects, microplastics can move from feeding larvae to non-feeding pupae in aquatic ecosystems and then the adults fly to land. Blood-sucking mosquitoes can participate in the microplastic cycle in the environment.

*2.5. Inhibition of Xenobiotics Transporters' Efflux Ability after Nanoplastics Exposure in Larval Japanese Medaka*

In this study, the authors designed two main tests. They were polystyrene (PS) nanoplastics exposure test and ATP-binding cassette (ABC) transporter inhibition test. Here, the study observed the disruption of the ABC efflux after exposure of Japanese larvae to PS nanoplastics (76 ± 7 nm). Nanoplastics (0.001–10 µg/mL) increased lipid peroxidation in fish larvae by 3–6 times compared with the control group, while the expression of efflux transporter-related genes (abcb6a, abcc2, and abcg2) was downregulated. Two types of rhodamine and fluorescein further validated the inhibitory ABC efflux capacity by rhodamine and fluorescein bioaccumulation results. After treatments with 10 µg/mL nanoplastics, the accumulation of rhodamine increased threefold. The excessive accumulation of fluorescein was also present in larvae treated with 0.01–0.1 µg/mL nanoplastics, with concentrations that were 1.7–1.8-fold higher than in the control group. Although the inhibition of the ABC transporter weakened after two hours of purification, the coexistence of nanoplastics and other contaminants still raise concerns. Overall, this indication suggests that nanoplastics may negatively affect the efflux capacity of ABC transporters and may lead to the accidental accumulation of organic pollutants that coexist in aquatic organisms.

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